MODERN COLLEGE OF ARTS, SCIENCE & COMMERCE

‘The statistical analysis of smart phone usage and increased risk of smart phone addiction’

SUBMITTED TO

DEPARTMENT OF

STATISTICS T.Y.B.SC 2020-21

CERTIFICATE

This is to certify that the project report entitled **'The statistical analysis of smart phone usage and increased risk of smart phone addiction'** is being Submitted by Ashique Khan, Ajinkya Patil, Aksil Sayyad, Geeta Wakale, Pavan Bhandare, Shubham Chavan, Nida Shaikh and Anas Ansari as a partial fulfillment for the award of the degree of the Bachelor of Science (B.Sc). This is a record of bonafide work carried out by them under supervision and guidance.

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Abstract

The study is based on the extent of mobile phone use amongst students and youngsters. In addition, the study is concerned with personal and family factors associated with the smart phone use and the link between problem observed is smart phone use and psychological health of the youth. If focuses on exploring the pattern of mobile phone usage among youth in India to delineate the acute of addictive behavior towards its usage. From this study it is observed that, there is increasing use of mobile phone in elder age groups. According to age group, there's changes observed in purpose of using smartphone. It is the biggest problem observed that children use phone for gaming purpose mostly. There is increasing tendency of use of smart phones in earlier ages.

The number of smart phone users in India from 2015 to 2022. For 2017, the number of smart phone users in India is estimated to reach 299.24 million, with the number of smart phone users worldwide forecast to exceed 2.3 billion users by that time.

The smart phone addiction magnitude in India ranged from 39% to 44% as per fixed effects calculated ($P < 0.0001$). Under different diagnostic criteria, the estimated prevalence ranges from 0 to 38%, with self-attribution of mobile phone addiction exceeding the prevalence estimated in the studies themselves. Smartphone addiction among Indian teens can not only damage interpersonal skills, but also it can lead to significant negative health risks and harmful psychological effects on Indian adolescents.

Key words

Addiction; mobile dependence; mobile phone; questionnaire; sex differences; adolescents

Introduction

Mobile phone addiction, a widely prevalent but unspoken issue, is silently creeping into the youth of many countries. Mobile phones are widely hailed for their technological benefit to mankind, the ease it creates in doing daily chores, and most of all, bridging of information as well as communication gaps among people. Rapid development of mobile phone technologies provides a rich selection of functions and improved portability that increases the prevalence of mobile phone use, especially among young people.4 Mobile phones, especially smart phones, are being increasingly used over recent years in both developed and developing countries .Despite offering great convenience, mobile phones can exert negative influences, induce extreme emotional changes and even cause serious physiological reactions, giving rise to the phenomenon popularly known as "mobile phone addiction". Mobile phone is considered a double-edged sword for young adults. On one hand, utilization of mobile phone facilitates young people to increase their social communication frequency, improve their relationships and make new friends. On the other hand, improper use of mobile phone influences young people negatively. Specifically, improper mobile phone use can reduce individual's concentration and the amount of information received during a typical class, block face to-face communication, and even lead to mental or physical stress. It is estimated that prevalence of mobile phone addicts ranges from 0% to 38% of mobile phone users across cultures and societies, suggesting at least 62% of mobile phone users are with possible addiction. A plethora of research and study to understand the effects of MPA on young adults has been done. For instance the research done by BMC assesses some of the self-perceived effect of increasing mobile phone usage on the well-being of college going students. Symptoms and the various common health effects were studied. Another research paper "Mobile phone to youngsters: necessity or addiction" studied about the addictive behaviors of mobile phone users. The purpose of similar studies is to identify the prevalence of MPA in young people, and the understanding of its effects on one's daily life.

STATISTICAL STATEMENT

EXCEL:-Microsoft Excel is a spreadsheet developed by Microsoft for Windows, macOs, Android and iOS. It feature calculation, graphing tool, pivot tables, and a macro programming language called visual basic for applications.

REGRESSION:- Regression is a statistical measurement used in finance, investing and other disciplines that attempts to determine the strength of the relationship between one dependent variable (usually denoted by Y) and a series of other changing variable (known as independent variable).

ANOVA:- Analysis of variance (ANOVA) is a collection of statistical models and their associated estimation procedure (such as the "variation" among and between groups) used to analyze the differences among group means in a sample . ANOVA was developed by statistician and evolutionary biologist Ronald Fisher.

R SOFTWARE:- R is a programming language and free software environment for statistical computing and graphics supported by the R Foundation for statistical computing . The R language is widely used among statisticians and data miners for statistical software and data analysis. Polls , data mining surveys ,and studies of scholarly literature databases show substantial increases in popularity in recent years.

PROPORTION TEST:- proportion test can be used for testing the null that the proportions (probabilities of success) in several groups are the same, or that they equal certain given values.

LOGISTIC REGRESSION

Logistic regression is the appropriate regression analysis to conduct when the dependent variable is dichotomous (binary) like all regression analysis, the logistic regression is a predictive analysis. Logistic Regression is used to describe data and to explain the relationship between one dependent binary variable and one or more nominal, ordinal, interval or ratio-level independent variables. Logistic Regression was used in the biological sciences in early twentieth century. It was then used in many social science applications. Logistic Regression is used when the dependent variable(target) is categorical.

The mathematical model of Logistic Regression

$$\log [p(x) /1 - p(x)]= \beta 0 + x \cdot \beta$$

Where:

P(x):linear function of x

X:Regressor

β0:Y intercept

β:Regression coefficient

ASSUMPTION:

Logistic Regression requires the dependent variable to be binary.

ANOVA

The one-way ANOVA presented in the Lesson is a simple case. In practice, research questions are rarely this "simple." ANOVA models become increasingly complex very quickly. In statistics, the two-way analysis of variance (ANOVA) is an extension of the one-way ANOVA that examines the influence of two different categorical independent variables on one continuous dependent variable. In its simplest form, ANOVA provides a statistical test of whether two or more population means are equal, and therefore generalizes the t-test beyond two means.

CRD(COMPLETELY RANDOMIZED DESIGN): In randomized statistical experiments, generalized randomized block designs (CRDs) are used to study the effects of one primary factor. For a CRD, each treatment is replicated at least two times. By randomization, that is to say the run sequence of the experimental units is determined randomly.

MATHEMATICAL MODEL:

Theone-way ANOVAmodelsallthesevariables as varyingindependentlyand

Y_{ij} / μ_{ij} , $\sigma^2 \sim$ □□□ $N(\mu_{ij}, \sigma^2)$

$\mu_{ij} = \mu + \alpha_i + \varepsilon_{ij}$

where μ is the grand mean, α_i is the additive main effect of level i^{th} from the first factor , and ε_{ij} is the non-additive interaction effect of treatment (i,j) from both factors

Assumptions

1. The errors are independent.
2. The errors have the same variance.
3. The errors are normally distributed.

TECHNICAL STATEMENT

The aim of project is to study the addiction behavior in different age groups the persons with or the people with different occupation the people with accommodation like home and hostel in both males and females. To study the which types of tools of apps the people are using most there are many side effects of using smart phones and alsosmart phone is useful in many ways. It depends upon for what purpose the smart phone you are using.

The factors we studied in logistic regression are as follows:

Y- Addiction present or not (Addicted-1, not addicted-0)

X1- No. of questions which shows habits of user and difficulties they suffer while using smartphone

X2- Total phone time usage

X3- No. of apps of photo and camera tools

X4- No. of apps of Social sites tools

X5- No. of apps of entertainment and gaming tools

X6- Occupation of user (Student- 1, Working- 2, Housewife- 3, Retired- 4)

X7- age of user (Below 18- 1, 18:25- 2, 26:40-3, 41:55- 4, Above 55: 5)

X8- Gender of user (Male-1, Female-2)

METHODOLOGY AND DATA COLLECTION

This study aimed to study the mobile phone addiction behavior between adults and youngsters. For this purpose questionnaires were accustomed to elicit the response of youth. Randomly people were selected as population without determination of any age criteria and statistical methods were used. Data collection of usage of total phone time of users is done by using **'My Phone Time'**.

Findings of this study discovered that majority of respondents are not able to have definite properties between their responsibility and commitments and there mobile phone usage and they are showing continuously intense addictive behavior and restlessness. Only a few are those who are not often involved in addictive usage patterns. Thus most youngsters use their smart phone on extreme limits and tend towards extreme behaviors leading towards addictive smart phone usage and it causes intense and severe affects over their health.

DATA

Addict	No of Questions	Hrs	Photo and Camera	Social	Entertainment And Gaming	Occupation	Age	Gender
Y	x1	x2	x3	x4	x5	x6	x7	x8
0	4	3	6	4	18	1	1	2
1	6	4	9	5	16	1	2	1
0	2	2	7	5	18	1	2	2
1	8	6	11	3	18	1	1	1
0	1	4	5	5	15	4	5	1
0	3	2	8	3	17	3	3	1
1	11	7	4	5	12	1	2	2
0	2	4	3	3	20	1	2	1
1	7	5	7	1	16	1	2	2
1	10	8	9	3	17	1	2	2
1	9	5	10	5	20	1	1	2
0	0	1	4	3	19	4	5	1
0	4	1	6	5	15	2	4	1
0	2	1	3	2	16	4	5	1
0	2	3	7	5	19	1	2	1
0	5	5	11	4	13	2	2	2
1	6	4	7	5	14	1	1	2
0	2	3	4	2	12	4	5	1
1	10	6	12	2	18	1	2	2
1	5	6	2	2	12	2	2	2
0	2	3	6	1	18	4	5	1
0	4	3	8	2	13	4	5	1
0	3	3	4	4	20	3	3	1
0	4	2	2	5	13	3	3	1
1	0	5	4	2	12	1	2	2
1	6	6	7	3	14	1	2	2
0	5	7	6	1	17	1	2	2
0	1	3	8	4	18	1	1	1
1	8	6	5	5	18	1	1	1
1	12	5	9	5	16	2	4	1
1	7	4	4	5	17	1	1	2
1	2	4	9	3	17	1	2	2
0	0	3	8	2	16	1	2	2
1	8	5	11	5	19	1	2	1
0	2	3	4	2	14	4	5	1
0	0	3	2	5	12	2	2	2

1	5	5	2	5	13	2	3	1
1	7	4	1	4	18	1	2	2
0	3	3	1	4	19	3	4	1
1	13	3	3	2	20	1	5	1
0	2	3	6	3	15	2	3	1
1	6	4	4	4	16	1	2	2
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0	0	3	4	4	15	1	1	2
1	9	4	3	5	18	1	2	1
1	7	4	8	5	20	2	3	1
1	10	4	4	3	19	2	3	1
1	5	4	13	3	19	2	2	2
0	1	3	8	5	19	2	3	1
1	8	5	2	3	15	1	2	2
1	6	4	7	4	14	2	3	1
1	9	5	10	5	17	1	2	2
1	11	4	2	1	17	4	5	1
1	3	4	4	2	16	1	2	1
1	6	5	3	2	15	1	2	2
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0	1	3	3	2	12	4	5	1
0	1	3	7	4	16	2	4	1
1	7	5	2	2	19	1	2	2
1	8	4	1	2	13	1	2	1
1	2	4	1	3	13	2	2	1

1	7	4	1	1	14	2	3	1
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1	6	4	7	5	20	1	2	2
1	9	4	2	1	19	1	2	1
1	5	4	2	2	13	1	2	1
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0	1	3	2	5	20	2	3	1
1	8	4	4	4	18	4	5	1
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1	3	4	2	2	18	2	2	1
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1	9	4	8	3	16	1	2	2

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0	1	3	7	2	14	1	2	2
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0	1	3	1	2	20	2	3	1
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0	3	3	4	2	18	1	2	1
1	7	4	1	5	14	2	3	1
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1	9	4	10	2	12	1	2	2
0	1	2	2	3	13	2	3	1
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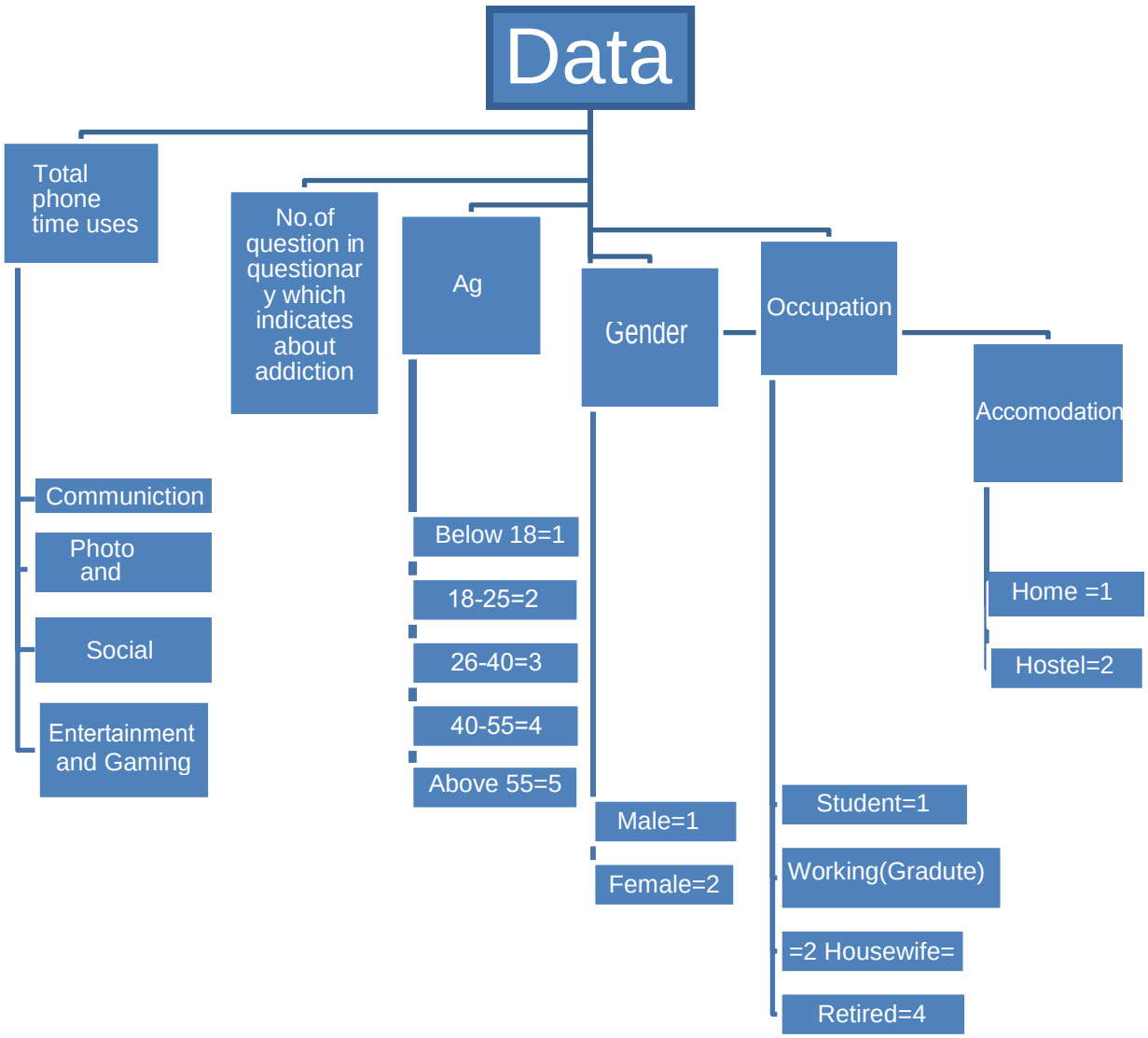
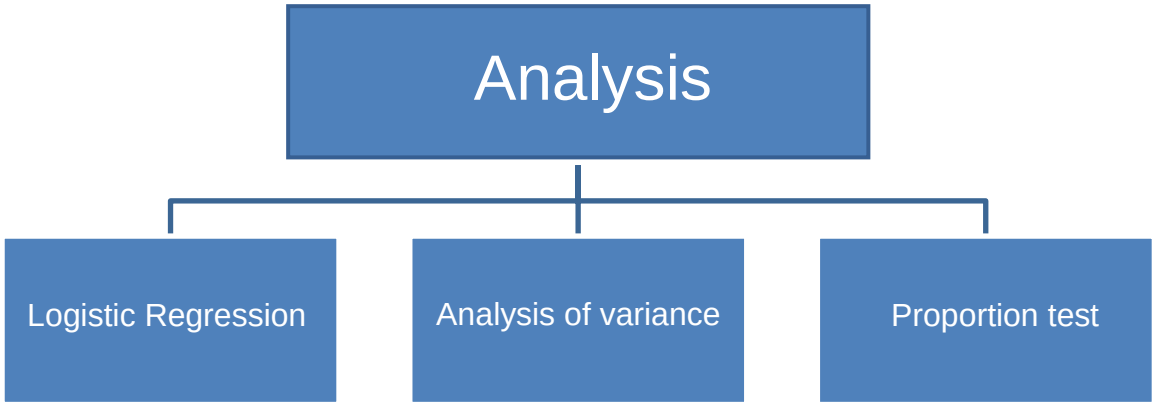
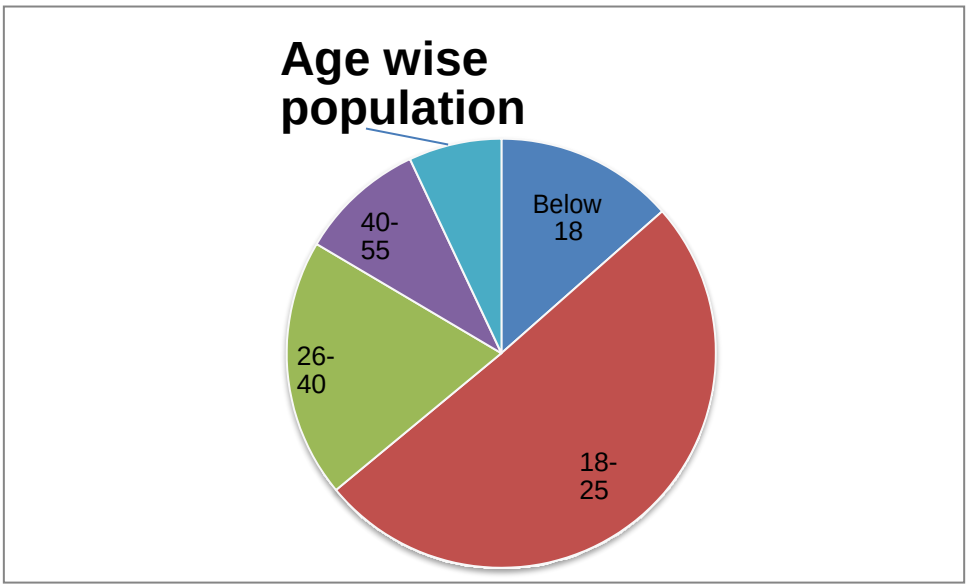
1	10	4	7	4	17	1	2	2

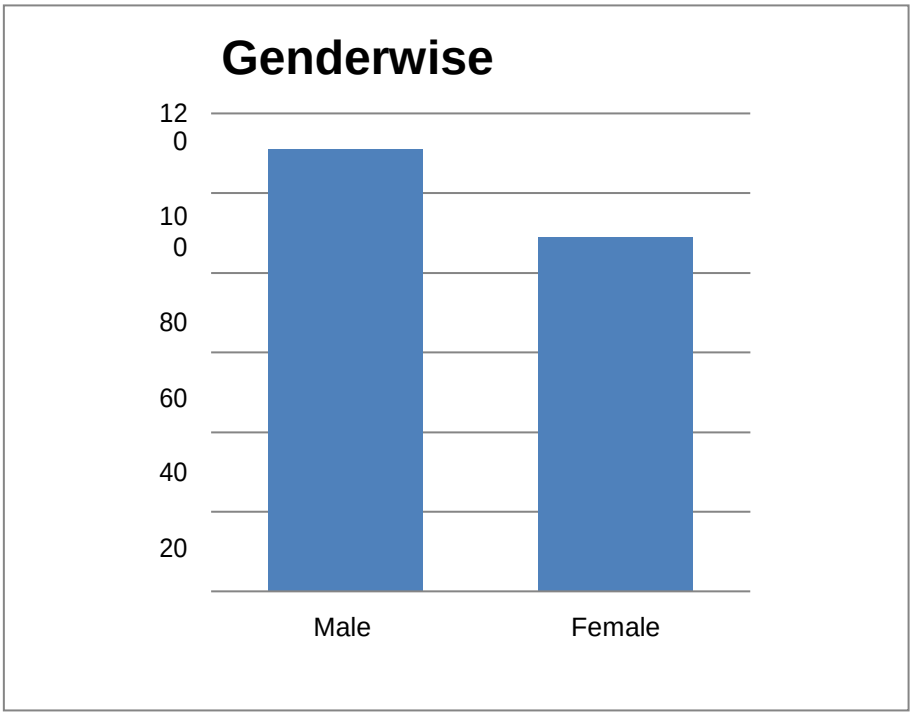

Data
Total phone time uses
No.of question in questionary which indicates about addiction
Ag
Gender
Occupation
Accomodation
Communiction
Photo and
Social
Entertainment and Gaming
Below 18=1
18-25=2
26-40=3
40-55=4
Above 55=5
Male=1
Female=2
Student=1
Working(Gradute)
=2 Housewife=
Retired=4
Home =1
Hostel=2


Analysis
Logistic Regression
Analysis of variance
Proportion test

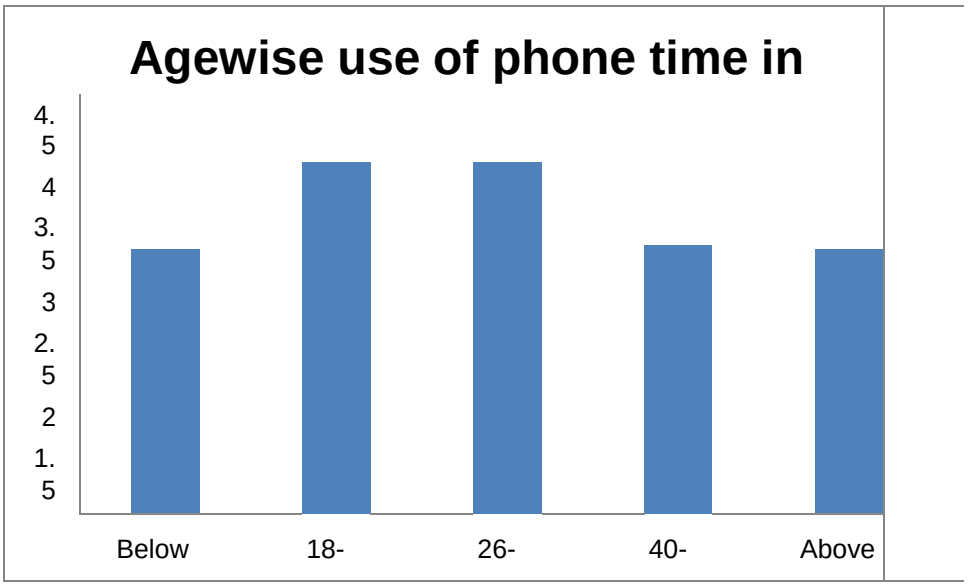
EXPLOROTARY DATA ANALYSIS



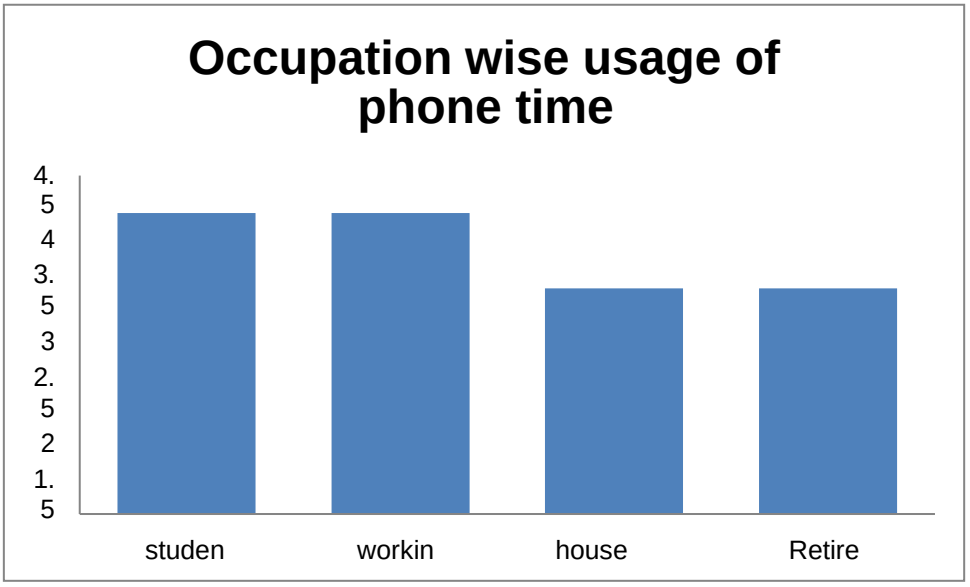
We taken here age group from 0-55 above distributed in five age groups. Here we can see that 50% population is in age group of 18-25. The least one is in age group above 55%.



This graph shows how much males and females are involved in these project.



There is difference in total phone time of use in all age groups. From above graph, it is observed that average use of 18-40 age group is high than other age groups.



Occupation wise use of phone time can be changed. Student and working age groups use their smart phones for various purpose.

LOGISTIC REGRESSION

Our response variable is binary with values ‘0’ and ‘1’. We are taking response variable as Addiction due to use of smart phone and corresponding dependent variables as total phone time usage, number of questions from questionnaire which shows about addiction behavior, use of Photo and Camera tool, use of social sites, use of entertainment and gaming tools, Occupation, age and gender.

ASSUMPTIONS: -

Binary logistic regression requires the dependent variable to be binary.

Call:

```
glm(formula = y ~ x1 + x2 + x3 + x4 + x5 + x6 + x7 + x8, family =
"binomial")
```

```
Deviance Residuals:
    Min       1Q   Median       3Q      Max
-3.7094  -0.1928   0.0094   0.0927   2.2521
```

```
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept) -6.37212    4.19897  -1.518  0.12913
x1           1.17929    0.25006   4.716  2.4e-06 ***
x2           1.58634    0.59558   2.664  0.00773 **
x3          -0.24790    0.16441  -1.508  0.13159
x4          -0.14585    0.28933  -0.504  0.61418
x5          -0.04731    0.15813  -0.299  0.76481
x6          -0.14184    0.84494  -0.168  0.86669
x7          -0.25333    0.70813  -0.358  0.72054
```

```
x8          -0.33199    1.07736  -0.308  0.75797

---

Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1


(Dispersion parameter for binomial family taken to be 1)


    Null deviance: 275.98 on 199 degrees of freedom

Residual deviance: 53.71 on 191 degrees of freedom

AIC: 71.71
```

For checking the assumptions:

1. From data we can say that response variable is binary.

The **p**-values of above regressors

Regressors	p-value	Decision	Inference
x1	2.4e-06	Accept H0 at 5% l.o.s.	Habits of users are significant effect on addiction behavior
x2	0.00773	Accept H0 at 5% l.o.s.	Total phone time use of users are significant effect on addiction behavior
x3	0.13159	Reject H0 at 5% l.o.s.	Photo and Camera tools are insignificant effect on addiction behavior
x4	0.61418	Reject H0 at 5% l.o.s.	Social Media apps are insignificant effect on addiction behavior
x5	0.76481	Reject H0 at 5% l.o.s.	Entertainment and gaming tools are insignificant effect on addiction behavior
x6	0.86669	Reject H0 at 5% l.o.s.	Occupation of users are significant effect on addiction behavior
x7	0.72054	Reject H0 at 5% l.o.s.	Age of users are significant effect on addiction behavior
x8	0.75797	Reject H0 at 5% l.o.s.	Gender of users are significant effect on addiction behavior

From p-values, we get the regression model as follows:

Y~x1+x2

Now we again apply Logistic Regression to fit the model.

```
> reg<-glm(y~x1+x2, family="binomial")
> summary(reg)

Call:
glm(formula = y ~ x1 + x2, family = "binomial")

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-3.7422  -0.2053   0.0135   0.1339   1.8702

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  -9.8974     2.0311  -4.873 1.10e-06 ***
x1            1.0445     0.2139   4.884 1.04e-06 ***
x2            1.6679     0.5755   2.898  0.00375 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 275.978  on 199  degrees of freedom
Residual deviance:  58.826  on 197  degrees of freedom
AIC: 64.826
```

Interpretation: From p-value of above regressors we obtain two significant regressors which are x1 and x2 i.e. addiction is mainly dependent on habits of user and how much time the user is using their phone.

Conclusion from Logistic Regression:

From the above analysis we can conclude that the addiction behavior of user is independent of user's age, gender, occupation and for what purpose they are using their smart phone. But addiction depends on the factor that how much time the user is using their phone. So many people waste their time on phone by using worthless apps.

ANOVA

Analysis of Variance (ANOVA) method is used to determine the effect of age criteria on the use of total phone time of users. Here we used Completely Randomized Design (CRD type) to study the above effect of age.

TESTING FOR AGE CRITERIA:

H_0: All age groups have same effect on total phone time

Vs

H_1: All age groups have different effect on total phone time

One-way ANOVA: Hrs versus Age

Source	DF	SS	MS	F	P
Age	4	297.566	74.392	104.53	0.000
Error	145	103.192	0.712		
Total	149	400.758			

S = 0.8436 R-Sq = 74.25% R-Sq(adj) = 73.54%

p-value from the table is **0.000**

As p-value < 0.05 (5% l.o.s.) hence we reject H_0

all age groups have different effect on total phone time

Now we have to compare all age criteria to one another by using Critical Difference (C.D.) test

H_0: $\square_{\square} = \square_{\square}$: $i \neq j$, $i,j = 1,2,3,4,5$

Vs

H_1: $\square_{\square} \neq \square_{\square}$: $i \neq j$, $i,j = 1,2,3,4,5$

Decision Criteria

Reject H_0 when $|y_i - y_j| \geq$ C.D.

Age 1	Age 2	Absolute Difference	C.D.	Decision
Below 18	**18-25**	1	0.183003744	Reject H_0
Below 18	**26-40**	1	0.211250516	Reject H_0
Below 18	**41-55**	0	0.252673811	Accept H_0
Below 18	**Above 55**	0	0.271729713	Accept H_0
18-25	**26-40**	0	0.15929975	Accept H_0
18-25	**41-55**	1	0.211172167	Reject H_0
18-25	**Above 55**	1	0.233637896	Reject H_0
26-40	**41-55**	1	0.236072223	Reject H_0
26-40	**Above 55**	1	0.256365124	Reject H_0
41-55	**Above 55**	0	0.291445279	Accept H_0

Hence form above table we can say that:

- Average phone time use of Below 18 age group is similar to the average phone time use of 41-55 age group.
- Average phone time use of Below 18 age group is similar to the average phone time use of age group above 55.
- Average phone time use of 18-25 age group is similar to the average phone time use of age group of 26-40.
- Average phone time use of 41-55 age group is similar to the average phone time use of age group above 55.

♦ Similar age groups means they both are affecting same on average whereas below 18 age group is not similar with 18-25, 26-40 age group, 18-25 age group is also not similar with 41-55 age group and age group above 55. Similarly age group 26-40 is not similar with age group 41-55 and age group above 55.

CONCLUSION FROM ANOVA:

From One-way ANOVA (CRD type) we can say that age significantly affects on user average phone time. There are some population similar to one another. It can be seen from Critical Difference test. Youngsters are using their smart phone for various purposes other than social media apps and entertainment apps but also they are not using their smart phone smartly. There are many apps due to which youngsters are addicted.

PROPORTION TEST

Proportion of addicted persons in all age groups

H0: There is same proportion of addicted persons in all age groups

Vs

H1: There is different proportion of addicted persons in all age groups

```
> x=c(11,68,17,8,4)
> n=c(27,100,39,19,15)
> prop.test(x,n,conf.level=0.95)

        5-sample test for equality of proportions without continuity
        correction

data: x out of n
X-squared = 17.097, df = 4, p-value = 0.001851
alternative hypothesis: two.sided
sample estimates:
  prop 1    prop 2    prop 3    prop 4    prop 5
0.4074074 0.6800000 0.4358974 0.4210526 0.2666667
```

Conclusion: As the p-value < 0.05.

Hence we reject H0.

There is different proportion of addicted persons in all age groups

Proportion of addicted persons in males and females

H0: There is same proportion of addicted persons in males and females

Vs

H1: There is different proportion of addicted persons in males and females

```
> x=c(53,55)
> n=c(111,89)
> prop.test(x,n,conf.level=0.95)

        2-sample test for equality of proportions with continuity correction

data: x out of n
X-squared = 3.3802, df = 1, p-value = 0.06599
alternative hypothesis: two.sided
95 percent confidence interval:
 -0.287823948  0.006823847
sample estimates:
   prop 1    prop 2
0.4774775 0.6179775
```

Conclusion: As the p-value > 0.05.

Hence we accept H0.

There is same proportion of addicted persons in males and females.

CONCLUSION

- No significant changes were found on mobile phone dependency behavior between participants having accommodation in house and hostel.
- One-fourth of the study population is having a feeling of wrist and hand because of smart phone usage which may lead to further physiological and physiological complications.
- Total phone time usage of users get changed from age to age, from person to person.
- There is no significant difference of total phone time usage gender wise.
- Addiction of users is mainly observed in 18-40 age groups.
- From questionnaire, we can conclude that due to increase in use of smart phone people get addicted to use of smart phone and due to that they are facing many difficulties in their day to day life and also in their social life.
- Constant urge to explore and experience new things, leading to excessive use of newer technologies is observed in youngsters.
- The way smart phone applications are designed, has a strong effect on human brain. They are designed to attract users, and increase the application outreach. This causes a huge attachment to one's phone.

Some Fascinating Facts:

- The average user will tap, swipe and click their phone 2,617 times a day
- 60% of users say that they can't live without their device.
- Average time spent on smartphones is 7 hrs 51 mins a day.
- India was 2nd highest in top 10 smartphone used countries in 2019.

Limitations

- In this project we study about only 200 persons. Because of limited population some criteria's may not be applicable on large scale.
- The population under statistical study is living in certain city.
- The data which we collect for study in of limited time.

Scope

- Impact of smart phone addiction on sleep pattern would have been studied in depth.
- This study can be extend for the study of electromagnetic radiation (EMR) produced by smart phones.
- The health problems raised due to smart phone addiction will be study separately.

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Appendix